

MEDICAL TEXTS ON CADMIUM

REFERENCE ONE

From 1963 until 1986, *The Handbook of Poisoning*, stated that Cadmium was used for plating metals and in the manufacture of bearing alloys, and silver solders. Cadmium melts at 321° Centigrade and the resultant fumes are the cause of acute inhalation toxicity, the clinical presentation of which is diverse from chronic exposure.

ACUTE INHALATION MANIFESTATIONS:

1. Metallic taste in the mouth, shortness of breath, chest pain, foamy or bloody sputum with cough, weakness, and pains in the legs. chest exam reveals bubbling rales. Urine formation may be diminished later. Progress of the disease is indicated by onset of fever, and signs of lung consolidation with retained fluid. Xray of the lungs will show diffuse increase in lung density; later, bronchial pneumonia.

Fatalities have occurred after inhalation of cadmium fumes. The exposure limit for cadmium dust or cadmium oxide fumes is 0.05mg/m³ (NIOSH 0.04 mg/m³). (It is not stated whether this is the level limit for toxicity and symptoms, or for death.) The mortality from acute inhalation nears 15 %. Survival for more than 4 days indicates recovery, but clinical recovery may take 6 months, and there may be long term sequelae (e.g. liver, renal, pulmonary changes, and cancer.)

CHRONIC INHALATION POISONING:

Loss of smell, cough, dyspnea, weight loss, anemia, irritability, and yellow-stained teeth. The liver and kidney may be damaged. The incidence of prostate carcinoma is increased. (recent literature finds lung cancer increased as well). Emphysema is found at autopsy.

CADMIUM INGESTION:

The handbook further states that ingestion of cadmium can be fatal, and that the dose for fatality is unknown. Cadmium plating is soluble in acid foods, such as fruit juices and vinegar. Ingestion of as little as 10 mg. will cause marked symptoms, with these findings:

Severe gastrointestinal inflammation and liver and kidney damage, manifested by: nausea, vomiting, diarrhea, headache, muscular aches, salivation, abdominal pain, shock, liver and renal failure. Most singular ingestion overdoses, recover in 24 hours. Chronic ongoing exposure is more common.

LABORATORY FINDINGS :

1. Urine: hematuria, proteinuria
2. Blood: red and white cell counts are low. ESR (sed rate) elevated.
3. Liver enzymes tests: abnormal.

TREATMENT:

The Handbook states obvious preventions and treatments of removal from exposure: not preparing or storing food in cadmium plated vessels and strictly observing the m.a.c (minimal allowable air concentration). And as for treatment, it mentions control of acute pulmonary edema, liver and renal failure, blocking gastrointestinal absorption and catharsis with Fleet's Phospho-Soda 30-60 ml diluted in 1:4 water, and chelation via Calcium disodium-edetate, and decries the use of dimercaprol (DMPS) for chelation.

CHELATION CONSISTS OF: formation of stable ring compounds by the coordination of electrons from the metallic elements with an unshared pair of electrons from a member of the organic compound. It forms readily soluble, practically non ionized and nontoxic compounds with multivalent metals.

Calcium or disodium edetate, or for short, EDTA (ethylene-diamine-tetra-acetate), *in addition to cadmium*, chelates: lead, ferric and ferrous iron, mercury, copper, nickel, zinc, cobalt, beryllium, and manganese. However, it binds most effectively with those metals which are bound more tightly than calcium: thus lead, cadmium, iron, zinc, manganese, beryllium and copper excesses are the expected treatable metals, leaving mercury, nickel and cobalt (as well as arsenic, antimony, etc.) to another

management.

The 4th Edition of the Handbook indicated treatment via **oral EDTA** seemed effective: however, the 11th Edition stated that Edetate is not metabolized by the body, and is poorly absorbed by the gastrointestinal tract. *The Handbook* states that oral administration of edetate is potentially harmful, since lead (or other of the toxic heavy metals) in the gastrointestinal tract is thereby chelated and more readily absorbed, thus the possibility exists that oral administration could increase the total body heavy metal, and thereby damage the liver and kidney.

There are well delineated clinical protocols for IV EDTA treatment, upon which the *Handbook* touches, mentioning in particular, intermittent short courses of treatment, replacement of beneficial minerals, and urinalysis with each course of treatment. Both IV and IM doses for lead removal are given, and it is implied the same dose is applicable for cadmium removal.

REFERENCE TWO

In the 1983 text, *Trace Elements, Hair Analysis and Nutrition*, by Passwater and Cranton, we find 40 references to support 8 pages of text on cadmium. The cumulative evidence was that pollution via cadmium was fast becoming more serious than lead pollution, and known to cause high blood pressure. It binds or inhibits vital enzymes, blocks nutrient utilization, especially zinc, vital to kidney function, thus causing the expected renal damage and failure.

In those dying from high blood pressure effects, there is a high cadmium to zinc ratio in the kidney, demonstrable in many cities around the globe. Several American cities show a direct statistical relationship to environmental cadmium levels and high blood pressure deaths. Animal studies confirmed the many links with cadmium and blood pressure and renal damage. With renal failure, low blood pressure can prevail, and lead to demise.

The authors develop the realization, from studying medical literature, that unsuspected chronic cadmium intoxication will lead to various symptoms attributed to other causes, rather than to cadmium toxicity, and that mild toxicity will become severe with continual mild exposure.

They detail the chronic exposure of a village along the Jintsue River in Japan in the mid 1970's, where in women, aged fifty to sixty years, suffered excessive lower back pains, that progressed to an agonizing waddle or total inability to walk. They shrieked "Itai! Itai!" meaning "ouch! ouch!". Their bones broke and half of them died before doctors discovered the cause. Their urinary excretion of cadmium, estimated to be 300-to-600 micrograms per day, was caused by cadmium, as a byproduct of mining zinc upstream, which dumped their wastes into the village drinking and crop irrigation water, impairing calcium metabolism and the calcium to phosphorus balance, thus causing Itai! Itai! disease.

This dramatic poisoning heralded an analysis of drinking water, finding that normal streams and reservoirs had, at the time, low cadmium levels: but that soft acid water picks up cadmium from water mains, pipes, fittings and solder. Many ice cube trays and other metal parts at the time were coated with cadmium to prevent corrosion.

Now, the mere industrial manufacture of these parts, and other uses of cadmium have grown to the point that most lakes and streams are now contaminated with industrial overflow of the many inclusive heavy metal poisons, including cadmium.

The literature from 1972 until 1983 was replete with findings of significance: that an adequate calcium intake can partially protect against heavy metal assimilation, as well as can supplementation with zinc, selenium, copper, iron and vitamin C; that a diet high in protein and pectin (from fruit) reduces cadmium absorption and retention; but that pregnancy and lactation, and deficiency of iron, calcium and vitamin D will cause cadmium accumulation at a rate 2 to 3 times higher than normal. It was found that breast milk is nearly void of traces of cadmium, even in toxic mothers, as the cadmium is resorbed by mother, thus keeping her in a toxic state: but when cadmium was found in the diet of infants, it was associated with a drastic decrease in verbal intelligence.

Mines, smelters and factories spew cadmium into the air and the settling of dust increases soil cadmium. Also, burning wastes and fertilization, create airborne cadmium. It is easily inhaled, and then settles into soil and water, to be ingested. Studies of the cadmium in the atmosphere of major cities and rural areas between 1960 to 1983 show that heavily industrialized cities, like Chicago had 0.062 micrograms per cubic meter, with most larger cities between 0.005 and 0.020, but that those figures at least doubled in the twenty-three comparative years; and adult exposure to the level in the air is roughly 20 times that, since adults inhale in the range of 20 cubic meters of air daily. It follows that the cumulative days exposure also doubled during the comparative twenty-three years -- or nearly so, depending on time spent outdoors, and the quality of indoor air filtration.

Sewage sludge is extremely high in cadmium, as is high phosphate fertilizer and crop irrigation water from industrial run-off. Wheat and rice concentrate cadmium, as do tomatoes, potatoes, and liver and kidney organ meats. Green leafy vegetables are particularly high. Crustaceans (shell fish), clams and oysters, and all fish, but particularly cod, tuna, flounder, and haddock, accumulate high levels -- 50 parts per billion, (ppb), or more. The dietary accumulations were extensively studied between 1972 and 1976.

The EPA through the 1970's issued sewage sludge cadmium limitations and numbers were set upon to gauge the allowable levels in food and food additives, fertilizers, and city water. {Dr. B.:*Stop and wonder what additives put cadmium in food and were not banned in the first place!*}

Also, during that time, cigarettes were studied and easily incriminated in the saga of cadmium toxicity. Briefly, these are the facts: inhaled cadmium is more absorbable than ingested cadmium; inhalation of cadmium fumes produces pulmonary emphysema; heavy smokers dying of chronic bronchitis and/or emphysema had mean cadmium levels more than 3x higher than other age cohorts dying of other causes; that 70 percent of the cadmium content of a cigarette passes into smoke; cadmium was shown to accumulate in the kidney of heavy smokers; cigarette smoking is linked to kidney cancer, as well as lung cancer, and prostate cancer, uretral, ureteral, and testicular; cadmium absorption averages 2 micrograms per pack. And remember, average city air, in 1960, added 0.1 to 0.4 micrograms daily.

Oak Ridge National Laboratory reported a lead-cadium link in soft water to arteriosclerosis, and demonstrated a slightly protective effect when calcium and magnesium appeared in the water.

It was noted that since cadmium retention in the blood is extremely low, that deposition into body organs is very rapid, hair analysis is a telling sample, distinguishing occupational from non-occupational exposure. In 1986, 1 part per million (ppm) on hair sample was the upper limit of acceptability by most laboratories.

The authors concluded with case studies, showing that headaches and musculoskeletal pain, and hypertension in adults, and childhood seizures, uncontrollable verbal sounds and shaking spells were reversible when cadmium was diagnoses and treated. It turned out that the child since birth was breast fed and then fed from the family organic garden. The soil was tested and found to contain 44 milligrams per gram of lead (46,000 ppm) and 380 ppm of cadmium. The leaves of the garden vegetables measured 14,000 ppm lead and 780 ppm cadmium. Unfortunately, mention of the source of garden enrichment was not made.

REFERENCE THREE

In 1972, Carl Pfeiffer Ph.D., M.D., wrote *Mental and Elemental Nutrients*. In the one chapter covering lead, mercury and cadmium together, he observed that cadmium poisoning is the most subtle metal poisoning (exceeded in subtlety by the trace good metals, copper and iron). He states that early galvanizing zinc contained cadmium as an impurity, and large galvanized water tanks were stored in basements of large apartment and office buildings. When cut up during removal after their failure, the welders became toxic on the fumes. Zinc smelters spew great excesses of cadmium into the air and water, contaminating the soil for miles around. Being a text on mental effects, he states that intoxication of the brain with heavy metals causes hyperactivity in animals and presumably in some children. Zinc is a sedative metal, and is displaced from brain tissue by the heavy metals.

END

{Dr. B has not finished the texts synopsis. But do see the Med Lit abstracts.}